Original Article

High Diagnostic Accuracy but Persistent Risk of Complicated Appendicitis: A Retrospective Analysis from Hail Province, Saudi Arabia

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Abstract

Context: Acute appendicitis is a common surgical emergency. While clinical diagnosis is generally effective, it is not perfect, potentially leading to negative appendectomies or delayed treatment. **Aims:** This study investigated the histopathological patterns of appendectomy specimens in King Khalid Hospital, Hail Province, Saudi Arabia, correlating them with preoperative clinical diagnoses to assess diagnostic accuracy and guide optimal management. **Subjects and Methods:** A retrospective analysis was conducted on 198 patients who underwent appendectomies between August 2023 and July 2024. Resected appendix specimens underwent histopathological examination and were categorized as inflamed, malignant, or benign. Clinical data and histopathological findings were compared using statistical analyses, including Fisher's exact test, to assess diagnostic accuracy and explore potential associations between patient demographics, appendicitis severity, and clinical presentation. **Results:** The study cohort consisted predominantly of young males (78.8%, mean age: 26 ± 9.2 years), with no pediatric cases included. The most common histopathological finding was an inflamed appendix (99.5%), with acute inflammation being most prevalent (86.9%). Perforation (10.1%) and gangrenous changes (2.5%) were also observed. A rare case of negative appendectomy (0.5%) was attributed to a perforated Meckel's diverticulum. **Conclusions:** This study demonstrates a high preoperative diagnostic accuracy for acute appendicitis. However, the occurrence of negative appendectomies and complicated cases, particularly in young adult males, highlights the need for continuous vigilance and refinement of diagnostic approaches. Further research exploring age- and sex-specific risk factors for complicated appendicitis is crucial to optimizing patient management strategies and minimizing unnecessary surgical interventions.

Keywords: *Appendectomy, cohort study, histopathological patterns, Saudi Arabia*

Introduction

Acute appendicitis remains the most common surgical emergency worldwide, often necessitating prompt surgical intervention to prevent complications such as perforation, sepsis, and peritonitis. Since its initial description by R. H. Fitz in 1886, the clinical diagnosis of appendicitis has been a cornerstone of surgical practice, yet it continues to pose a significant diagnostic challenge.[1] This is particularly due to the variability in its presentation, which can mimic other conditions within the right iliac fossa, leading to both overdiagnosis and missed cases. The stakes of misdiagnosis are high, as delays in treatment can result in increased morbidity and mortality.[2]

In light of these challenges, many surgeons opt for immediate appendectomy upon a clinical diagnosis of appendicitis, despite the potential for removing a noninflamed appendix. This approach is driven by the risks associated with delayed surgery, such as the development of more severe complications.[3] However, the correlation between clinical findings and histopathological outcomes remains a critical consideration in determining the necessity of surgery, particularly in cases where the appendix appears normal during operation.[4]

Histopathological examination of resected appendices is routinely performed to confirm the diagnosis and to uncover any incidental findings that may influence patient management.[5] Despite this, there is ongoing debate regarding the justification for the removal of a normal-looking appendix and the implications of such findings on surgical practice.[6] This study aims to assess the accuracy of clinical diagnosis for acute appendicitis and

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explore potential demographic risk factors for complicated cases in Hail Province, Saudi Arabia. By examining these correlations, the study aims to provide insights into the accuracy of clinical judgment and the underlying reasons for appendectomy in this region.

Subjects and Methods

Study design and setting

This retrospective study analyzes histopathological data from appendectomy specimens collected at King Khalid Hospital's Department of Pathology in Hail, Saudi Arabia. The study population encompasses all patients who underwent appendectomy between August 2023 and July 2024. Patients' clinical data, including demographics, presenting symptoms, and preoperative findings, were retrieved from their medical records. Diagnosis of appendiceal pathology was established through conventional histopathological examination.

Each resected appendix specimen underwent thorough histological analysis to determine the presence and nature of any pathological changes. Specimens were categorized into one of three pathology classifications: inflammation, malignancy, or benign lesion.

Statistical analysis

Statistical analysis was performed using SPSS (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY, USA: IBM Corp). Descriptive statistics were used to summarize the data. Fisher's exact test was employed to assess the statistical significance of associations between categorical variables. Statistical significance was defined as a $P < 0.05$. All analyses were conducted with a 95% confidence level.

Results

A total of 198 patients who underwent appendectomy between August 2023 and July 2024 were included in this study. The majority of patients were male (n = 156, 78.8%) with a mean age of 26 ± 9.2 years, whereas 42 (21.2%) were female and had a mean age of 28 ± 3.3 years. Patient age ranged from 14 to 118 years. No pediatric patients (age <14 years) were included in this study. The distribution of patients by age and sex is shown in Table 1.

Of the 198 appendectomy specimens examined, 197 (99.5%) showed evidence of inflammation. Acute inflammation was the most prevalent finding (86.9%), followed by perforation (10.1%) and gangrenous changes (2.5%). A single case (0.5%) of negative appendectomy was attributed to a perforated Meckel's diverticulum. Table 2 summarizes the surgical observations.

Table 3 illustrates the distribution of appendicitis pathology by sex among the study participants. Inflamed appendicitis was the most prevalent diagnosis, identified in 136 out of 156 (87.2%) males and 36 out of 42 (85.7%) females. Perforated appendicitis was observed in 17 out of 156 (10.9%) males and 3 out of 42 (7.1%) females. Gangrenous appendicitis was less common, occurring in 2 out of 156 (1.3%) males and 3 out of 42 (7.1%) females. Only one case of negative appendicitis, attributed to a perforated Meckel's diverticulum, was observed in a male patient (0.5%). These findings suggest a slightly higher proportion of complicated appendicitis (perforated and gangrenous) among males compared to females in this study.

Table 4 presents the distribution of appendectomy findings stratified by age group. Inflamed appendicitis exhibited a bimodal distribution [Figure 1], with the highest prevalence observed in the 21–30-year age group (63/172, 36.6%), followed by the 10–20-year age group (52/172, 30.2%). Perforated appendicitis was more common in younger age ranges, with 10 out of 20 cases (50%) occurring in individuals under 30 years of age. Gangrenous appendicitis, conversely, demonstrated an increasing prevalence with advancing age, accounting for 2 out of 5 cases (40%) in the 41–50 years age group and 1 out of 5 cases (20%) in those older than 50 years. These findings suggest a potential trend toward increased severity of appendicitis with increasing age.

Table 1: Distribution of patients by age and sex

Age group	Males	Females	Total
10–20	45	12	57
21–30	59	16	75
31–40	33	5	38
41–50	15	6	21
>50	4	3	7
Total	156	42	198

Table 2: Surgical observations made during appendectomies performed on patients with clinical diagnosis of acute appendicitis

Peroperative findings	*n* (%)
Perforated Meckel's diverticulum (negative appendicitis)	1 (0.5)
Inflamed appendix (in different stages)	
Inflamed	172 (86.9)
Perforated	20 (10.1)
Gangrenous	5 (2.5)

Table 3: Description of appendectomy by pathology and sex

Diagnosis	Males	Females	Total
Inflamed appendicitis	136	36	172
Perforated appendicitis	17	3	20
Gangrenous appendicitis	2	3	5
Negative appendicitis	1	0	1
Total	156	42	198

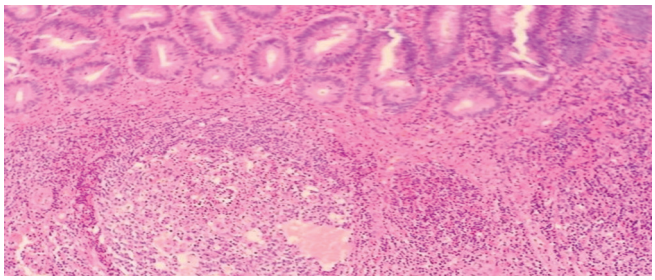

Figure 1: Acute appendicitis

Table 4: Description of appendectomy by pathology and age

Diagnosis age	10–20	21–30	31–40	41–50	>50	Total
Inflamed appendicitis	52	63	33	19	5	172
Perforated appendicitis	3	10	4	2	1	20
Gangrenous appendicitis	1	0	1	2	1	5
Negative appendicitis	1	0	0	0	0	1
Total	57	73	38	23	7	198

Discussion

This retrospective study investigated the histopathological patterns of appendectomy specimens in Hail Province, Saudi Arabia, correlating them with preoperative clinical diagnoses of acute appendicitis. Our findings contribute valuable insights into diagnostic accuracy and provide a basis for optimizing appendectomy practices within the region.

The demographic analysis of patients undergoing appendectomy in this study reveals significant trends in age and sex distribution that are consistent with existing literature on appendicitis. The cohort comprised 198 patients, predominantly male (n = 156, 78.8%), with a mean age of 26 years (±9.2). This male predominance aligns with findings from Wu *et al*.,[7] who noted that acute appendicitis occurs predominantly in males, particularly within the age range of 20–30 years. The absence of pediatric subjects in this study is noteworthy, as pediatric appendicitis often presents differently and may involve distinct diagnostic challenges compared to adult cases.[8]

The age distribution of patients, as shown in Table 1, indicates that the most frequently observed age group was 21–30 years (n = 75), followed by 10–20 years (n = 57), and 31–40 years (n = 38). This finding is consistent with previous studies that have reported a peak incidence of appendicitis in young adults, particularly those in their late teens to early thirties.[9] The mean age of patients in this study (26 years ± 9.2) further corroborates this trend, as similar studies have documented mean ages ranging from the late 20s to early 30s for appendectomy patients.[10]

The data also suggest that the clinical presentation of appendicitis in this cohort may be influenced by demographic factors. For instance, the predominance of younger adults undergoing appendectomy may reflect lifestyle factors, such as dietary habits and physical activity levels, which have been associated with the incidence of appendicitis.[8,11] In addition, the higher incidence of appendicitis in males may be attributed to biological differences in immune response and anatomical factors that predispose males to appendiceal inflammation.[7,12]

The absence of pediatric patients in this cohort raises important considerations regarding the management of appendicitis across different age groups. Pediatric appendicitis is often characterized by atypical presentations and may require different diagnostic approaches compared to adults. For example, the use of imaging techniques such as ultrasound is more common in pediatric populations to avoid unnecessary radiation exposure from computed tomography (CT) scans.[13] The findings from this study emphasize the need for tailored diagnostic and treatment protocols that consider the unique characteristics of appendicitis in various age demographics. Furthermore, the implications of age and sex distribution on postoperative outcomes and complications warrant further investigation. Previous studies have indicated that younger patients tend to have better postoperative outcomes compared to older adults, who may experience higher rates of complications such as perforation and abscess formation.[14] The current study's findings regarding the predominance of younger patients undergoing appendectomy may suggest a lower risk profile for this cohort, although further research is needed to explore the long-term outcomes associated with appendectomy in different age groups.

The findings presented in Table 2 highlight critical insights into the surgical observations made during the appendectomies performed on patients diagnosed with acute appendicitis. The overwhelming majority of patients (99.5%, n = 197) exhibited a grossly inflamed appendix, underscoring the effectiveness of clinical diagnosis in identifying cases that necessitate surgical intervention. However, the presence of one patient (0.5%) with a perforated Meckel's diverticulum, resulting in a negative appendectomy, illustrates the inherent limitations of clinical assessments in accurately diagnosing appendicitis. This aligns with previous studies that have reported negative appendectomy rates ranging from 5% to 30%, emphasizing the need for improved diagnostic modalities to minimize unnecessary surgical procedures.[15]

Among the patients with confirmed appendicitis, acute inflammation was the most prevalent finding, observed in 86.9% (n = 172) of cases. This finding is consistent with the literature, which indicates that acute appendicitis is the most common presentation in patients undergoing appendectomy.[16] Furthermore, the subset of patients exhibiting more severe pathologies, including gangrenous changes (2.5%, n = 5) and perforation (10.1%, n = 20), reflects the spectrum of appendiceal disease severity

that can occur. The incidence of perforated appendicitis, which is reported to occur in approximately 20% of cases, highlights the importance of timely diagnosis and intervention to prevent complications.[3]

The data also suggest that while clinical diagnosis is generally reliable, it is not infallible. The occurrence of a negative appendectomy due to a perforated Meckel's diverticulum emphasizes the necessity for a thorough preoperative evaluation, including imaging studies when appropriate. The use of ultrasound and CT has been advocated in various studies to enhance diagnostic accuracy and reduce the rate of negative appendectomies.[17,18] For instance, the incorporation of ultrasound as a noninvasive diagnostic tool has shown promise in improving the accuracy of appendicitis diagnoses, particularly in pediatric populations.[17]

Moreover, the findings from this study resonate with the ongoing debate regarding the management of uncomplicated appendicitis. Recent literature has explored nonoperative treatment options, such as antibiotic therapy, as alternatives to appendectomy, particularly in cases of uncomplicated appendicitis reported that patients treated with antibiotics had comparable quality of life outcomes at follow-up compared to those who underwent appendectomy, suggesting that a conservative approach may be viable in select cases.[19] However, the risk of complications associated with delayed intervention remains a concern, as untreated appendicitis can progress to perforation and peritonitis, necessitating surgical intervention.[3,20]

The results presented in Table 3 concerning the distribution of appendicitis pathology by sex reveal significant insights into the prevalence and types of appendicitis among male and female patients. The data indicate that inflamed appendicitis is the most common diagnosis, accounting for 87.2% of males and 85.7% of females in the study cohort. This aligns with existing literature that suggests a predominance of inflamed appendicitis in both genders, although the overall incidence of appendicitis tends to be higher in males.[21,22] The findings also highlight a notable occurrence of complicated appendicitis, particularly perforated appendicitis, which was observed in 10.9% of males and 7.1% of females. This trend is consistent with previous studies that have identified the male gender as a potential risk factor for the development of complications such as perforation.[23,24] The slightly higher proportion of complicated cases among males in this study may be attributed to biological and behavioral factors, including differences in immune response and healthcare-seeking behavior.[25]

The results presented in Table 4 regarding the distribution of appendectomy findings by age group provide critical insights into the epidemiology and pathology of appendicitis. The data reveal a bimodal distribution of inflamed appendicitis, with the highest prevalence observed in the 21–30-year age group (36.6%) and a significant proportion also in the 10–20-year age group (30.2%). This finding is consistent with existing literature that identifies younger populations, particularly those in their late teens and early twenties, as having a higher incidence of appendicitis.[26,27] The predominance of inflamed appendicitis in these age groups may be attributed to factors such as increased physical activity and dietary habits that predispose younger individuals to appendiceal obstruction.[28]

The data also indicate that perforated appendicitis is more prevalent in younger individuals, with 50% of cases occurring in those under 30 years of age. This aligns with previous studies that have reported a higher risk of perforation in younger patients, likely due to delayed presentation and diagnosis.[29,30] The time-dependent progression of appendicitis, where luminal obstruction leads to increased intraluminal pressure, venous congestion, and ultimately perforation, underscores the importance of timely medical intervention.[31] The findings suggest that younger patients may experience a more rapid progression of appendicitis, necessitating prompt surgical management to mitigate the risk of complications.

Conversely, gangrenous appendicitis demonstrated an increasing prevalence with advancing age, with 40% of cases occurring in the 41–50-year age group and 20% in those older than 50 years. This trend suggests a potential correlation between age and the severity of appendicitis, as older patients may present with more advanced disease due to factors such as comorbidities, altered immune responses, and possibly a higher threshold for seeking medical care.[32,33] The literature supports the notion that older adults are at increased risk for complications associated with appendicitis, including gangrene and perforation, which can lead to higher morbidity and mortality rates.[30,33]

The single case of negative appendicitis in the 10–20-year age group further emphasizes the diagnostic challenges associated with appendicitis, particularly in younger patients. Negative appendectomy rates can be significant, and misdiagnosis can lead to unnecessary surgical interventions, highlighting the need for improved diagnostic accuracy.[27,34] The economic implications of negative appendectomies are also noteworthy, as they contribute to increased healthcare costs and resource utilization.[27]

Strength and limitation

This study provides valuable insights into the local epidemiology and histopathological patterns of appendicitis in Hail Province. However, several limitations inherent to its retrospective design and single-center setting should be considered. The small sample size, particularly within specific age and sex subgroups, limits the generalizability of our findings. Moreover, the lack of data on clinical scoring systems, such as the Alvarado score, prevents assessment of their efficacy in our population.

Conclusions

This study, while limited by its retrospective design, contributes valuable insights into the management of acute appendicitis in Hail Province. Our findings highlight the need for heightened awareness among healthcare providers regarding the variable presentation of appendicitis across different age groups. The concerning trend of increasing disease severity with age, particularly the higher incidence of gangrenous appendicitis in older adults, emphasizes the importance of early intervention and age-specific diagnostic protocols. Further research is warranted to explore the factors contributing to this age-related trend and to evaluate the potential benefits of nonoperative management strategies for younger patients with uncomplicated appendicitis. Ultimately, these efforts will help optimize appendicitis management and improve patient outcomes in our region.

Ethics approval

The study protocol adhered to the principles outlined in the 2013 Declaration of Helsinki and received approval from the Ethics Committee of the College of Medicine at the University of Ha'il, Saudi Arabia.

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Conflicts of interest

There are no conflicts of interest.

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